Paper No. 15

TITLE: INSTRUMENTAL MEASUREMENT OF THE TOTAL PARTICULATE MATTER OF CIGARETTE SMOKE

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ABSTRACT: A Cigarette Smoke Monitor (CSM) for the instrumental measurement of cigarette smoke total particulate matter (TPM) has been developed. The cigarette holder consists of a hollow tube containing a small orifice. Upstream of the orifice is an optical smoke sensor. Between the cigarette and the cigarette holder is a short length of tubing containing two small mixing orifices and chambers. A device developed by Arthur D. Little, Inc., measures pressure drop across the orifice and outputs a signal which is directly proportional to the flow rate through the cigarette holder. The smoke concentration signal from the sensor in the cigarette holder is fed into an electronic signal processor. The processor multiplies the smoke concentration by the flow rate. The product is integrated, and the integral is indicative of the amount of smoke particulate matter passing through the cigarette holder. Evaluation of the CSM was performed by smoking cigarettes under varying puff conditions. TPM deliveries were compared with the CSM response. The response of the smoke monitor was directly proportional to the amount of TPM collected on filter pads downstream of the cigarette holder over a range of 0.5 mg TPM per cigarette to 35 mg per cigarette. Comparison of predicted TPM deliveries with those actually observed indicated that the monitor is accurate to within 1 mg TPM or 20% of the actual TPM generated, whichever is larger. (Research sponsored by the National Cancer Institute under Interagency Agreement DOE No. 40-485-74 NIH(NCI) No. YO1CP60206 under Union Carbide Corporation contract W-7405-eng-26 with the U.S. Department of Energy.)

REVIEW: The author reported that an improvement had been made in the procedure since the abstract was submitted and that smoke concentration and flow rate could now be measured simultaneously. He also claimed that the instrument is designed to measure human smoking behavior. The smoking of cigarettes with ventilation filters gives nonhomogenous smoke, hence the need for the mixing chamber. Linear response is reported for cigarettes with TPM deliveries as high as 40 mg per cigarette, although for cigarettes at the higher deliveries there is a nonzero intercept. Puff volume was varied from 17-75 ml and puff duration from 1-3 sec and the same linearity was found. At low TPM deliveries (1 mg) there is linearity with an intercept through zero. The author reports adequate sensitivity for the ultra low delivery cigarettes (0.01). Like some of us at R&D, he has had difficulty in correlating his procedure with the gravimetric procedure because of the inherent errors in weighing such a small amount of TPM. I do not feel that this procedure would have merit over our fluorescence procedure. Moreover, the "Black Box" used to integrate the signals seems to me a definite drawback.

-Reviewed by W. Harvey

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